

ANNALS OF SURGERY

VOL. XI.I

JANUARY, 1905

No. 1

ORIGINAL MEMOIRS.

AN ADJUSTABLE METALLIC INTERDENTAL SPLINT FOR THE TREATMENT OF FRACTURE OF THE LOWER JAW.¹

WITH REPORT OF CASES IN WHICH IT HAS BEEN APPLIED BY THE AUTHOR.

BY RUDOLPH MATAS, M.D.,

OF NEW ORLEANS, LA.,

Professor of Surgery in the Tulane University of Louisiana; Surgeon to Charity Hospital.

THE ideals aimed at in the treatment of fracture of the lower jaw are: 1. To reduce the fracture accurately. 2. To maintain reduction and immobilization of the fragments until firm union is obtained. 3. To provide for the hygiene of the mouth, which suffers constantly from salivary stagnation and putrid decomposition. 4. To meet the preceding indications with the least interference with the oral and maxillary functions (feeding and speech).

To satisfy all these desiderata fully and without some sacrifice of the last two conditions is evidently impossible in *all* cases, and the manner in which these indications can be met will depend upon various circumstances, among which the most important are the extent and situation of the fracture, which are alone sufficient to determine whether the fracture can be successfully treated by *partial* or *total* immobilization of the

¹ Read before the American Surgical Association, June, 1904.

jaw. It is evident that if the functions of the temporomaxillary joint are not interfered with and that the fracture line can be kept at rest during repair, thus permitting the patient to open and shut his mouth at will, that the cleanliness of the mouth and oral functions (feeding and speech) will be maintained with a minimum of discomfort to the patient.

One of the most notable advances in the treatment of fractures is the tendency to diminish, as much as possible, the period of functional disability during the process of repair. The aim of the surgeon is to secure the conditions necessary for perfect osseous union with the least interference with function. This is well exemplified in the ambulant treatment of fractures of the lower extremity, which provides for the conditions necessary to perfect bone union without seriously restricting locomotion. If this is true of fractures of the extremities, how much more important and desirable it must be to preserve the functions of the jaw during the process of repair when this bone is fractured! The serious consequences of the functional disability of the lower jaw, caused by fracture, are manifested, not only by interference with the speech and feeding of the patient, but more particularly by the disastrous effects of salivary putrefaction and oral sepsis, which have given this fracture a special interest to the surgeons of all times. Apart from this, the actual technical difficulties encountered in maintaining the apposition of the broken fragments during repair are, in many cases, very great and account for the vast amount of mechanical ingenuity and thought which has been expended on the subject by succeeding generations of medical men from the days of Hippocrates and Celsus to the present time. That the problems involved are real and have challenged the ingenuity of the best minds of the profession is best told by the bibliography of the subject. A hasty glance at the *Index Catalogue of the Surgeon-General's Library*, including the second series, Vol. viii, 1903, shows references to over 250 articles on fracture of the lower jaw. By consulting these references and other sources of information, we have collected the descriptions of over seventy-five different appliances, devices, and

methods of treating this special fracture. This list, which is very incomplete, is made up largely of the contributions of the surgical writers of the eighteenth and the first half of the nineteenth centuries. The bibliography of this fracture is a monumental repository of the progress of surgery, in which are found, almost in chronological order, the illustrious names in surgery of all the ages. In looking over the list of appliances and references to the methods of treatment which have been employed in the past, we are struck by the fact that almost every one of the mechanical devices and methods of treatment at present in use, and regarded as new by our contemporaries, find their prototypes in ancient publications and have been known and applied, at least in principle, by old and forgotten authors. Apparently the present generation has only succeeded in resurrecting old principles and applying them again in a modernized garb. Real progress has undoubtedly been accomplished by adapting to the fundamentally correct ideas of the older authors the improved technique of dental mechanics and prosthetics, by using better material and appliances for taking impressions of the jaws, thus improving the quality of the interdental splints which are still necessary in some cases; but, apart from this, we fail to find anything essentially new in our modern armament.* To the student of this subject and to the experienced surgeon, it is evident that, notwithstanding the multitude of resources and abundance of appliances, no single method or device will avail for all cases, and that a certain eclecticism and judicious selection of methods must be exercised in order to obtain the best results in individual cases. No one will deny that the most perfect results would be obtained in all cases by the collaboration with the surgeon of a dentist skilled in the methods of oral prosthetics and dental mechanics; but as this is practically impossible in the urgent conditions in

* In further confirmation of this statement, see the erudite monograph by Béranger Feraud (L. J. B.): *Traité de l'immobilisation directe des fragments osseux dans les fractures*; Paris, 1870, and the encyclopædic article by F. Guyon, entitled, "Maxillaire (os) Pathologie," in the *Dictionnaire Dechambre*, Tome 5me, deuxième série, 1872.

which these patients present themselves to the surgeon for treatment, it is proper that the simplest methods available to the general surgeon, with the material at hand, should be utilized, at least, in the first or provisional dressings. Fortunately, a great many of these fractures are simple, and the tendency to the displacement of the fragments is so slight that recovery has been known to take place without any sort of treatment whatever. Boyer reported a case of a water-carrier, who refused to be treated with any restricting bandage, and recovered with very slight deformity, notwithstanding that he used his jaws in chewing, eating, and drinking as usual; and, also, another curious case is reported by A. Bérard, that of a child, whose fractured jaw would not unite until all the immobilizing appliances had been removed, when union quickly took place (Guyon). Of course, these are exceptional cases, which, by their very rarity, emphasize the rule.

In the Charity Hospital of New Orleans, where twelve or thirteen cases are treated annually (in the last twenty months, up to October 1, twenty-five cases of fractured lower jaw were admitted), a large proportion of these patients are treated in the clinics by immobilization with a chin-piece of moulded material and a Barton bandage; fully ten out of twenty-five cases were treated exclusively by this method and apparently with fairly good functional results. In these cases in which the lesions of the mucosa and the soft parts are comparatively insignificant and the tendency to displacement is slight, the patients, who are usually of the laboring class, usually suffer comparatively little pain and stand the privation from solid food with resignation and cheerfulness. In this class of patients the immobilization of the jaw by chin-splint and a sling or head bandage is not absolute, and soon allows of a certain amount of separation of the jaws, which favors the cleansing of the mouth by irrigation with antiseptic solutions and permits comparatively easy alimentation with liquid and soft foods.

On the other hand, there are many cases of single and multiple fracture, in which the tendency to recurrent displacement

after reduction is most obstinate; in these cases the damage to the buccal mucosa is considerable and the tendency to buccal sepsis and submucous infection is great. It is in this class of fractures that the most perfect coaptation is desirable with the greatest freedom of access to the interior of the mouth for purposes of disinfection. These are the patients who have furnished the material for the greatest number of inventions, and, even now, offer problems which tax the originality and resources of the practical surgeon and the dental specialist. Judging by the current literature, they are still fruitful material for discussions in journals and societies.* It is fortunate that the majority of these fractures occur in the mandibular arch, in front of the angles and within the line of the teeth, and that it is possible, in many of these, to immobilize the fragments without interfering with the movements of the temporomaxillary joint.

In fractures of this class, if the teeth are strong and firmly implanted, the broken fragments may be held in place by the old Celsian plan of wiring the adjoining teeth, using them as binding-posts. This method, which has been perfected and modernized by Angle and Löhers, who use clamps and bars to lock the teeth together, is only rarely applicable because the teeth are either loosened by the injury or subsequently mobilized by the strong traction of the jaws and muscles at the line of fracture. To obviate this difficulty, the peridental wire splints of Hammond, Sauer, and Martin (of Lyons), and the fracture clamp of Shotwell have been devised and applied with success by their advocates; but, as they require special skill in their application and they also offer comparatively little resistance to muscular traction, are only applicable in certain favorable cases. Far more accurate and reliable are the moulded dental splints which fit over the crowns of the teeth following the contour of the dental arch; they are made of metal, hard rubber, or vulcanite, cast on moulds of the teeth out of plaster-

* In the *Index Medicus* will be found references to fifteen separate articles on fractured lower jaws which have appeared in journals and society transactions from January to September, 1904.

of-Paris impressions. These dental splints were originally suggested, long ago, by Fouchard, Prestat, Malgaigne, Morel-Lavallée, and have been modernized and perfected by Kingsley, and before him by Gunning, Hayward, Bean, Moore, Lonsdale. Hill, in this country and England; by Martin in France; by Weber, Suersen, Haun, Anton Witzel, and quite recently by Warnekros and Kersting in Germany; but all these, while admirably meeting the conditions in the hands of their inventors, have a disadvantage that they require the assistance of specialists in dental mechanics, whose services are not always available at the time when these cases are brought to the surgeon for treatment; and even when the specialist is available, they often require much time and many trials for their preparation and application. Nevertheless, there are many cases in which splints made from casts are required in order to make them fit accurately over the dental arch. This is particularly true of those cases in which the contour of the dental arch is made very irregular by the loss of several teeth at different points, or in those cases of partial fracture of the jaw in which a large section of the alveolar process is broken, carrying with it a number of teeth which wobble constantly with the fragment of bone to which they are attached.

We purposely exclude from consideration in this connection the comparatively rare fractures of the rami, of the condyloid, and of the coronoid processes in which no interdental immobilizing appliances, as a rule, are applicable, and in which the suppression of all jaw motion is absolutely mandatory as an essential to repair. Neither shall we consider those extreme cases of multiple comminuted fractures of the jaw which result from gunshot and railroad injuries and other forms of violence in which the number and mobility of the osseous fragments, together with the enormous damage done to the soft parts, precludes all possibility of using any device which requires some fixed point of support for its successful application. In such instances, the question of immobilization and osseous repair is secondary to the more vital and pressing demands of drainage and asepsis; the correction of deformity

and impairment of function being relegated to a secondary plane in meeting graver complications.

Therefore, if we leave out of consideration the two extreme groups of jaw fractures, *i.e.*, the very simple, with little tendency to displacement, on the one hand; and the very serious, compound, multiple, and complicated cases, on the other, in which no sort of restraining appliance is available to prevent deformity, etc., there is still the middle class, previously referred to, which it would appear desirable and advantageous to treat by some ready method that would satisfactorily meet the requirements of asepsis and repair with the least discomfort to the patient.

The presence of a considerable number of these troublesome fractures in a large hospital service has, for many years, impressed me with this need. I have felt the want of an appliance which could be adapted to the conditions which we find in a great number, if not the majority, of these patients, and which could be readily and successfully adjusted by any medical man with ordinary surgical training without the need of calling upon a specialist in dental or oral mechanics for its application.

While the idea of a universal splint for fractures of the lower jaw that will fit all patients is, of course, absurd, it is not unreasonable to hope that a comparatively simple contrivance can be devised which will be serviceable in a large number of the more common types of this injury, as they present themselves in our clinics. Reasoning from the data of experience, which show that this fracture occurs chiefly in men (90 per cent.); that it occurs in the adult (dentulous) period of life, from the twentieth to the fiftieth year (in the last twenty-five cases of this fracture attended in the emergency service of the Charity Hospital of New Orleans, the average age of the patient was twenty-three years); and that fully 90 per cent. of these fractures occur in some part of the anterior or projecting segment of the maxilla in front of and including the angles, it is not a vain hope that by a proper selection of material a splint

may be devised which will permit of adaptation to a large number of these patients.

That the same need has been felt by others is very apparent in the writings of the older surgeons of the past century. Bush (1822), Houzelot (1826), Joussett (1833), Malgaigne (1847), Morel-Lavallée (second appliance, 1853), Rüttnick, Kluge, and others too numerous to mention, all thought of appliances which acted more or less on the same principle, *i.e.*, that of a clamp which held the broken fragments of the jaw in the grip of a plate fitted over the teeth, and an extra-buccal piece, which was adjusted over the chin. A great variety of models were thus designed, made of various materials; some of them very ingenious and no doubt useful in the special cases in which they were applied; but they all appear to have failed in some essential, which was necessary for general utility, as is shown by the fact that they have never retained a permanent place in the armamentarium. The chief defects that can now be recognized in these older splints is in the use of material in the dental plates which lacked adaptability to the numerous variations and conditions of the dental arch which are met in fractures.

In later days this objection has been overcome, as far as individual cases are concerned, by the use of moulded hard rubber or metallic splints, which are moulded or cast over plaster impressions of the dental arch of the particular patient for whom they are intended. These dental splints may be quite sufficient in themselves, as stated previously in this communication, to hold the broken fragments in position, or they are attached to outside bars or braces, which project from the mouth and hold the dental plate firmly to an adjustable chin-piece. In this way the primitive and crude models of Rüttnick, Morel-Lavallée, and others have been modernized through the efforts of the dentists of the present day, notably by Kingsley and a host of others in this country; by Martin, of Lyons; by Lohman and A. Witzel, and others in Germany. The objection to these, however, from the point of view of the surgeon who has to deal most often with these fractures in large surgi-

cal clinics, is that they fail to meet the requirements of emergency and charity practice. These patients, as a rule, apply first to the general surgeon, whose duty it is to meet the indications as thoroughly as possible. If the patient is to be transferred to the care of a dental specialist, days must pass before a perfectly fitting splint can be attached; in the meantime, if the displacement is not properly corrected, the patient suffers great hardship.

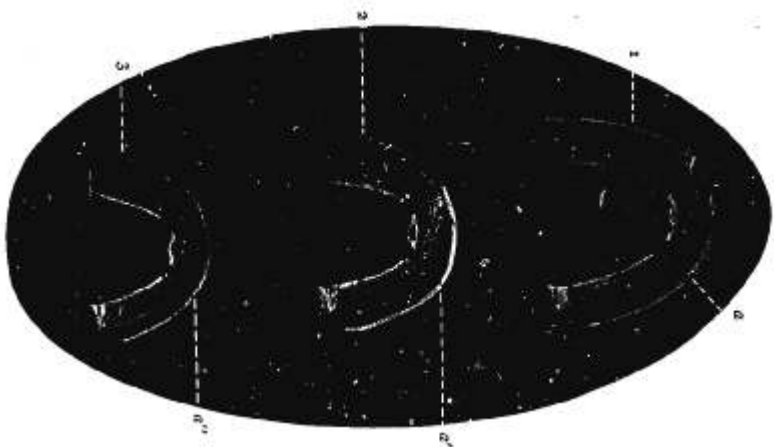
As far back as 1897 I had occasion to exhibit to the Orleans Parish Medical Society (*vide Transactions* of this society for 1897) a modification of a metallic splint, devised with the objects previously stated in view, by Dr. Robert C. Ackland, of St. Bartholomew's Hospital, London, and described by him in the *British Medical Journal* of April 1, 1893. At that time the splint appeared to meet the conditions of the average adult case of fracture of the jaw, theoretically, quite well; but, with increasing experience, I had to abandon it, because the dental mouth-piece, which fits over the arch of the teeth, was not flexible enough to permit its adjustment to the numerous variations of the arch that are met in practice; neither was the chin-plate adjustable to the various degrees of prognathism; moreover, the projecting twin bars which connect the dental plate with the chin-piece not only interfered with the sphincter functions of the mouth, permitting the escape of fluids and dribbling of saliva, but they caused deep ulceration at the angles of the mouth and so much distress to the patient that it had to be abandoned. For a while we tried other methods and also resorted to the suture of fragments in the multiple, compound, and more difficult cases, but the results have not justified the general adoption of this method, except in a few selected cases. The admission last winter of a number of fractures of the lower jaw in our clinics, in which the tendency to displacement was very marked, led us again to experiment with a new metallic splint. While this splint is not in the least new in principle, it is original in its construction and in the combination of different suggestions from various sources which we have found of value in

overcoming the practical difficulties which we have encountered.

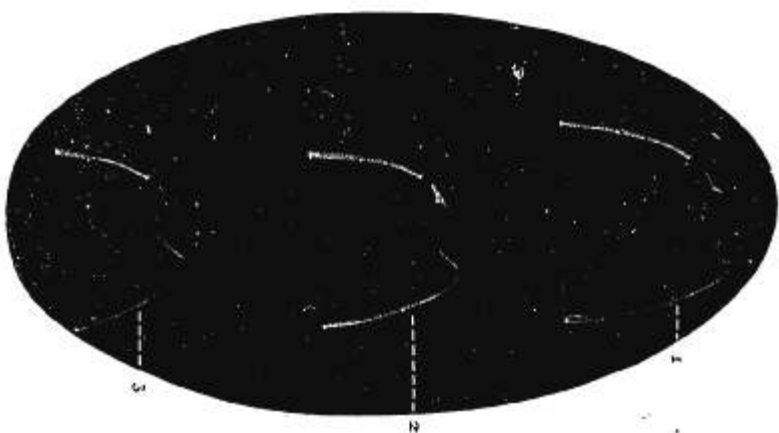
[The description that follows applies to the latest improved model, which we have tried only in one case. The first five cases reported at the end of this paper were treated with the first two models in which the dental piece or gutter was permanently fixed to the clamp and was not provided with the Wiley cuts, which make the present dental splints so much easier of adjustment to different jaws.]

The splint is constructed on the principle of a clamp, which holds the entire projecting arch of the jaw (from the chin to the angles) firmly in the grip of a flexible mouth-piece, which fits like a gutter over the entire dental arch; and, of an external plate or chin-cup, which extends from the symphysis to the angle. The mouth-piece and chin-plate are both detachable; the chin-cup is made adjustable to various degrees of prognathism by a sliding joint fixed by a pin and thumb-screw. The appliance, therefore, consists of three component parts, the details of which are as follows:

1. The *mouth-piece* or *dental splint proper*. This is horse-shoe in shape, and in the latest model is made after the pattern of the impression trays used by dentists to take casts of the lower dental arch. It is hollowed in three planes to fit loosely over the crowns of the teeth, the groove or gutter broadening from before backward to correspond with the increasing diameters of the molars. The edges of the splint form two flanges or rims which project downward; the outer flange extending to the neck of the teeth on the outer or buccal side; the inner flange or rim dipping to a lower level almost touching the gums on the inner or lingual side. This dental piece is made of block tin and is indented approximately on a level with the bicuspid by two deep cuts which penetrate the gutter to its outer rim, leaving a narrow wedge-like space, which is closed at the apex by the outer or labial rim of the splint. These cuts were originally suggested by Dr. J. K. Wiley to increase the flexibility of the dental impression trays in making impressions of the



Figs. 1 and 2.—Superior and inferior views of three detachable and interchangeable mouth-pieces, or dental plates, which are supplied with each splint. No. 1, *large size*, for adults; No. 2, *medium size*, for youths; No. 3, *small size*, for children. In addition to the softness of the metal used (block tin), which allows each mouth-piece to be adjusted to the contour of the jaw and teeth, the adjustment and adaptation of these splints to individual cases are further obtained by cutting partial sections (*a* & *a'*) in each mouth-piece, as suggested by Dr. G. K. Wiley, in the manufacture of the adjustable impression trays used in dental practice. The hollow groove in each mouth-piece (Fig. 2) can be filled with the soft moulding compound, or dental wax, used in dental practice. In this way loose teeth are held in place, the mobility of the splint is reduced to a minimum, and the difficulty of obtaining a uniform compression caused by the vertical irregularities of the teeth is overcome.



lower jaw. The softness and flexibility of the metal of which the splint is made, together with the Wiley cuts, allow the operator to adjust the splint to the varying contour of the lower dental arch as it is met in different individuals.

After studying the dental arches and maxillary contour of fifty different persons of both sexes and various ages, from the fifth to the sixtieth year, I had the splint made in three different sizes: the smallest for children, the medium size for youths and young women, and the largest size for full-grown adults. From these different sizes a selection can be made to fit the jaw of almost any normal individual who is likely to suffer from this injury.

In addition to the ease with which the splint can be moulded to the outline of the dental arch, the breadth of the gutter can be increased and otherwise altered by stretching the flanges and modelling them with a pair of ordinary hand-pincers. The dental gutter is also provided with a deep groove or slot in the centre of its inner or labial surface, which fits the hook at the tip of the clamp and holds it very firmly in position when it is locked. By this arrangement the splint is easily attached to the clamp after it has been adjusted to the jaw.

2. The *chin-piece* is made of perforated aluminum and is shaped to fit the contour of the jaw. It can be moved backward and forward on a sliding joint, which is adjusted by a thumb-screw and is attached to the lower limb of the clamp. In order to prevent injurious pressure on the skin of the chin, it is padded with cotton wadding, covered with a layer of gauze, smeared with oxide of zinc ointment.

3. The *clamp* which holds the mouth and chin-pieces together is made of soft steel and consists of an upper and lower limb screwed together at a considerable distance in front of the mouth. The upper limb projects from the middle of the mouth and is curved over the lower lip so as to allow the mouth to be closed, a very necessary provision to prevent salivary dribbling and to permit a complete control of the mouth in drinking and eating. The pressure required to hold the jaw firmly in the grasp of the intra- and extra-buccal pieces is obtained by

a screw attached by a swivel-joint to the upper limb of the clamp, the pressure being regulated by a thumb-screw, which acts on the lower limb of the appliance. (Fig. 3.)

Application of the Splint.—The chief object of this splint is to immobilize the broken fragments of the jaw without restricting its movements as a whole, thus permitting the mouth to be opened and closed at will. It is especially intended for compound fractures of the maxillary arch (symphysis and body), whether single or multiple, in which there is a marked tendency to recurrent displacement and that require frequent inspection and antiseptic irrigation of the oral cavity. It is obvious that in fractures involving the angles and rami of the jaw or the condyloid and coronoid processes, or in the graver cases of gunshot and other injuries in which there is great comminution of the jaws with laceration of the soft parts, that total immobilization of the maxilla is necessary and that the splint as a clamp cannot be used. In some of the cases the dental gutter or mouth-piece may be applied with a chin bandage after the reduction of the fracture. This part of the appliance is then used solely as an interdental splint and as an adjunct to the moulded chin-splint used in such cases and held in place with liquid glass, starch, or plaster-of-Paris bandage. The best chin-splint in such cases is a piece of porous blanket or coarse flannel, thoroughly soaked in plaster cream. This is readily moulded to the contour of the chin and jaw and allowed to dry *in situ*, any excess of the cloth being trimmed off while the plaster is setting. It is understood that the skin must be thoroughly shaved and lubricated with vaseline before applying the plaster.

If we take, as an example, a typical case in which the jaw is broken obliquely through the body, the first step is to shave the skin and disinfect it in the usual manner. If there are wounds which require suture, they should be closed, preferably with aseptic zinc oxide adhesive plaster strips, which secure the closest coaptation without the risk of stitch abscesses. A general anæsthetic may or may not be required, according to the peculiarities of the case. The mouth should be thoroughly dis-



FIG. 3.—Author's adjustable metallic splint for fracture of the lower jaw (latest model). The splint consists of the following detachable parts: (a) a mouth-piece of soft metal (block tin; (b) a clamp adjusted and tightened with a screw; (c) a chin-plate (of perforated aluminum), which can be moved backward or forward by sliding on the lower limb of the clamp. This is fixed and held in place by a thumb-screw.



FIG. 4.—Lateral view of the splint *in situ* as shown on adult skull.



FIG. 5.—Front view.



FIG. 6.—Interior view, showing the adaptation of the hollow dental plate to the contour of the teeth on their lingual aspect. All these illustrations show the clamp-like action by which the splint holds the maxilla, and its mode of action in all fractures of the symphysis and body as far back as the angle of the jaw.



FIG. 7.—A. S., lower jaw fractured by falling on a tree while alighting from a car in motion. Double compound fracture. One line of fracture dividing the body of the jaw obliquely at angle on the right side; the other broke the body of bone between the left lateral incisor and canine. Reduction and permanent apposition impossible until the splint was applied. Excellent and functional and anatomical results after wearing the splint for twenty-one days.



FIG. 8.—J. H., compound fracture of lower jaw, caused by fist blow. Line of fracture oblique, bisecting lower jaw at angle and terminating above behind last molar tooth. Great displacement and mobility of fragments. Reduction and apposition only obtained by splint. Barton bandage used to immobilize jaws with the splint. Splint worn eighteen days, and followed by excellent results.



FIG. 9.—E. B., struck on the jaw with a club; compound fracture. Lower jaw broken completely between left external incisor and canine. Splint worn twenty-eight days without inconvenience and with perfect results.



FIG. 10.—Miss N. F., lower jaw broken by fist blow. Oblique simple fracture of body on level with second molar; submucous break, with lateral displacement of left bicuspid and large fragment of alveolus. Perfect result after wearing splint seventeen days.

infected as carefully as possible by copious irrigation with a hot lysol solution (1 per cent.). After reducing the fracture, the contour of the dental arch should be restored, and while the bone is held in place by combined external and internal manipulation, one of the metallic dental gutters is selected, according to the age of the patient and size of the jaw, and fitted on the arch of the teeth. Usually the splint requires some moulding with the fingers before a fairly accurate fit can be obtained. If the splint fits well, it will usually hold the fragments in apposition by pressing it firmly against the teeth while making downward and forward traction towards the chin. In many cases in which the teeth are loose or missing in places, it will be necessary to fill the gutter of the tray with a modelling composition or wax used by dentists in making impressions of the teeth. I have found the "Excel" and S. S. White modelling compounds, sold in all dental dépôts, especially useful for this purpose; they are quickly softened by dipping in hot water and can be spread very easily over the inner surface of the tray. While the modelling compound is still soft in the gutter splint, this is applied to the dental arch and allowed to remain *in situ* until it becomes hard by cooling. In this way the loose teeth are held in position, the gaps between them are filled up, and the splint is fixed in place. The outside clamp is now adjusted. Special care must be observed in protecting the skin of the chin, which is frequently contused and liable to inflammatory œdema. This is best done by thoroughly padding the chin-plate with cotton wadding and gauze, smoothed over with zinc ointment. After the chin-plate is adjusted, the clamp is tightened with a screw with sufficient firmness to hold the mouth-piece in place. The patient is taught how to irrigate his mouth with a fountain syringe, the irrigations to be thorough and frequent; every hour or two during the day is not too often. In cases in which there is marked contusion of the soft parts and tendency to swelling, it is necessary to relax the tension of the screw at frequent intervals to prevent blistering and pressure necrosis of the skin of the chin. In these cases it is necessary to im-

mobilize the jaws during the first few days until the swelling has subsided, using for this purpose a Barton, Gibson, or a sling bandage, which will reinforce the splint and keep it in position while the tension of the clamp is relaxed. After the swelling has subsided, the outside bandages are removed and the splint alone is used, allowing the patient to open his mouth freely for all purposes. Even then, however, it is important that the tension of the clamp be relaxed at various intervals, according to the tolerance of the patient. So necessary it is to protect the skin of the chin from the effects of undue pressure.*

CLINICAL REPORTS OF CASES TO ILLUSTRATE THE USE OF AUTHOR'S SPLINT.†

CASE I.—*Double Compound Fracture; One through the Left Body, the Other through the Right Angle of the Lower Jaw.*—A. S., a German lad, aged eighteen years. On December 19, 1903, while under the influence of whiskey, he attempted to alight from a moving street-car and was struck full in the face by a small tree. An ambulance was at once called for and he was carried to the hospital, reaching there about 6 P.M. He was unconscious when first seen by the ambulance surgeons, but soon recovered. His whole face was horribly contused, looking like a mass of jelly, but the only bone injury was a double compound fracture of the lower maxilla; one being an oblique fracture through the angle on the right, the other through the body, between the lateral incisor and the canine tooth on the left. There was no great deformity at the interdental fracture, the right

* In closing this paper, I desire to thank my assistants and friends, Dr. H. H. Rightor (now of Helena, Ark.), to whom I am especially indebted for valuable suggestions and diligent observations in the first five cases in which the splint was used. To Dr. U. Maes for valuable assistance in making the last model; and to Mr. W. E. Sistrunk, resident interne, Charity Hospital, for clinical observations and statistical data. Also to the McDermott Surgical Instrument Company of this city, who now manufacture the splint and supply it to the trade, for their valuable co-operation.

† The first four observations are abstracted from the original histories written by Dr. H. H. Rightor (Tulane Class, 1904), who embodied them in his graduation thesis, entitled, "A New Splint for Fracture of the Lower Jaw, with Reports of Cases."

fragment being slightly anterior to the left; at the angle, however, the anterior fragment was displaced under the posterior for one-half inch. A cardboard chin-piece was moulded to the jaw and Barton's bandage was applied over it. This in nowise approximated the ends of the bone and seemed to increase the pain. He suffered intensely all night, requiring morphine hypodermically. The following morning the bandages were removed and the mouth thoroughly irrigated. The splint designed by Dr. Matas was applied. After reducing the fracture it held the bones in perfect apposition. Though the angular fracture was behind the line of the teeth, the patient was able to use his jaws without discomfort. Nevertheless, since his two upper central incisors were missing and there would be no difficulty in feeding him, it was deemed more prudent to apply a bandage in order to immobilize the jaws. In attempting to nourish him by means of a rubber tube with a funnel attached, it was found that the upper bar of the clamp pressed on the lower lip, preventing the perfect closure of the mouth, thereby rendering sucking impossible and allowing dribbling of saliva. Another splint was made with an upward curve over the lower lip, which permitted the mouth to close perfectly. (Fig. 7.) The after-treatment was simplicity itself. The patient irrigated his own mouth every two hours with a gallon of 0.5 per cent. lysol solution, keeping it sweet and clean. The diet was limited to liquids for a few days, and then, when the outside bandage was removed, a more liberal dietary was allowed. Every fourth day the clamp was loosened and the chin was wiped with alcohol. His recovery was uneventful. On the twenty-first day the splint was taken off and the result found to be perfect. There was no deformity and the teeth articulated well. The lower set was somewhat blackened from the long contact with the metal, but a few brushings with a tooth-powder was all that was needed to restore the original color and polish.

CASE II.—*Single Compound Oblique Fracture involving Angle of the Jaw.*—J. H., muscular white man, aged twenty years. On Monday, January 9, 1904, he became intoxicated, and when on his way home got into an altercation with two grown negro men. They finally came to blows, and one of them landed square on his left jaw with his bare fist. The blow knocked the patient down; he was unconscious for a short time, during which his opponents fled. He soon recovered and walked to a

neighboring drug store, suffering no great pain, except when attempting to speak. The deformity was so marked that a diagnosis of fracture of the jaw was made on inspection. The examination showed that the line of the fracture was an oblique one, bisecting the angle of the jaw; the anterior fragment was displaced behind and below the ramus. It was impossible for him to close his mouth; crepitus abnormal mobility, etc., in fact, all the classical signs of fracture were present. Digital examination of the mouth showed that the line of fracture terminated just behind the last molar tooth on the left side. The mucous membrane was torn for over an inch. The assistant house surgeon, who attended him, met with no difficulty in accurately reducing the fracture, but found that it was impossible to maintain reduction by the usual routine method. The last splint devised by Dr. Matas and used on the preceding case was readily introduced, and over this a modified Barton's bandage applied. There was now no tendency to recurrence; the pain was immediately relieved, and he never suffered after. The subsequent treatment was the same as in Case I. This patient had also a missing tooth, and through this space he was nourished and the oral cavity irrigated. The splint was removed on the eighteenth day, and, with the exception of a small amount of callus on the outer surface of the bone, no trace of injury remained.

CASE III.—*Compound Fracture of the Body of the Jaw between Canine and Incisor Teeth.*—E. B., white male, aged twenty-three years. On January 13, 1904, while he and a crowd of companions were drinking, he got into a fight with his brother-in-law. According to the patient's story, he had the best of it, his opponent being on the ground and he on top of him. While they were in this position, a brother of the opponent struck the patient full across the right face with a club, "knocking him senseless." He remained unconscious during the night, bleeding from the jaw all the time. The following day he was taken to the station and brought by train to New Orleans, thence to the Charity Hospital, arriving there twenty-six hours after the injury. He was very weak and pale from loss of blood. It was determined that he had a fracture of the lower jaw, compound externally and internally; the line of the fracture being between the left lateral incisor and the canine tooth, extending the whole depth of the jaw. There was a tendency to displacement on motion.

The mouth was thoroughly irrigated, the face shaved, the external wound dressed. The splint first used on Case I was applied, as the improved one was still in the mouth of Case II. Fortunately, the man had extra long teeth, and the curve on the upper limb of the clamp was not necessary, and he was able to close his lips perfectly. (Fig. 9.) No bandages were necessary in this case, excepting a small piece of adhesive plaster to hold the dressings on the external wounds. He was able to open and close his mouth from this on without pain. Irrigation was practised, as in the other case. In a few days the mucous membrane had healed, and he was allowed soft foods. Mastication caused no disturbance of the fragments. About the time that the splint should have been permanently removed—the eighteenth day—the interne assigned to the service was taken sick, and, as the patient was loitering around, caring for himself, he was in some way overlooked, and allowed to use the splint twenty-eight days. At the end of that time it was removed. The union was firm and without appreciable callus. There was, however, a pressure ulcer, the size of a twenty-five-cent piece, under the symphysis due to insufficient padding of the chin-piece and neglect of the skin. This healed readily under treatment.

CASE IV.—*Compound Double Fracture, involving the Body of the Lower Jaw, between the Centre and Lateral Incisor and through the Body obliquely into the Angle on the Same Side, complicated with Fracture of the Right Upper Jaw opening into the Antrum; also fractured Zygoma and Contusion of the Brain.*—No history could be obtained of this case, except that the patient, who was a colored man, aged twenty-three years, had been the victim of a railroad accident. He was admitted on March 12, 1904, four days after the injury. When admitted he was delirious and in a profound septic condition. The features were unrecognizable on account of the great swelling, and the mouth emitted a horribly foul and unbearable odor. After recognizing the fractures of the jaw (lower), the splint used in Case II was applied, and held the ends of the bones in perfect apposition. As there was no tendency for displacement, no bandages were applied. Copious irrigations were practised hourly to disinfect the mouth, which could be opened with comparative ease, on account of the fixation obtained by the splint. In this way the

local condition of the mouth was very much improved. The patient died on the fourth day after admission from the effects of the contusion and sepsis. The autopsy confirmed the clinical diagnosis. This case is quoted simply to show that the fractured jaw was well controlled by the splint and permitted free and copious irrigation of the mouth while the fragments were held in apposition.

CASE V.—*Alveolar Fracture involving the Bicuspid Teeth on the Left; complete Fracture through the Body obliquely to the Angle on the Right.*—Miss N. F., aged twenty years, on June 28, 1904, was assaulted by an unknown negro who struck her a terrific blow on the face with his fist. She was stunned without becoming wholly unconscious. She was taken to the hospital in a cab, where an attempt was made to fit on one of the splints used by Dr. Matas. This was one of the early models, consisting of a single mouth-piece, which was permanently attached to the clamp. This was found too long to fit, and a simple bandage, with a chin-splint, was substituted for it. On the second day after the injury she applied directly to Dr. Matas for treatment at his private office, where a model of the splint similar to the one used in the hospital was adjusted to her dental arch, but not until the interdental piece or gutter had been shortened. After this alteration the splint fitted perfectly, and the fragments were held in perfect apposition. (Fig. 10.) She was taught how to irrigate her mouth, and wore the splint constantly without any other bandage or restriction to the movements of the jaw. The splint was removed seventeen days after it had been applied, when it was found that the union was sufficiently firm to dispense with the appliance. There was no deformity or appreciable irregularity in the line of the teeth. The splint was removed every day for a week, and then every second day, to change the padding under the chin and to wash the skin with alcohol. The ease with which this patient could speak, eat, and drink with the splint on was remarkable.

CASE VI.—(Reported by Mr. Sistrunk, interne, Charity Hospital.)—R. A. T., male, aged twenty-five years. May 22, 1904, while boxing with a friend (both using boxing-gloves), was struck on the right side of the lower jaw. He suffered excruciating pains and could scarcely talk. He came at once to the hospital, where he was found to have a *compound transverse*

fracture of the right half of the lower jaw, midway between the symphysis and the angle. The teeth upon the side nearest the angle of the jaw were raised above the others, and the broken ends of the bone could be seen protruding through the lacerated wound in the gum. After reducing the fracture, the splint devised by Dr. Matas was applied and held the fragments in perfect apposition. The splint gave him almost instant relief, and after its application the patient could easily talk and swallow without much pain. He returned the next day, and the splint was removed and the mouth irrigated with a 1 per cent. solution of carbolic acid. The removal of the splint was followed by considerable pain, and the patient begged to have the splint replaced. This was repeated every day for ten successive days, when it was found that the bones remained in position without the splint. By this time an ulcer had developed under the tongue, which was attributed to pressure. In consequence of this ulcer and the fact that the bones had united sufficiently to prevent displacement, the splint was removed. The patient was discharged on June 3, at his own request, with a Barton bandage put on to hold the dressings under the chin and as a protection against displacement of the fracture. When he was discharged, no motion or crepitus could be obtained and the teeth were on a level.